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REACTION OF WHEAT, BARLEY, AND RYE VARIETIES TO STRIPE RUST IN THE PACIFIC NORTHWEST [1]

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United States Department of Agriculture, Bureau of Plant Industry, in cooperation with the Idaho Agricultural Experiment Station

CONTENTS

INTRODUCTION

Since the discovery of stripe rust (*Puccinia glumarum* (Schmidt) Eriks. and Henn.) in the United States in 1915, considerable work has been done to determine its host range. In 1923 Hungerford and Owens (*5*) [2] reported the reaction of a number of wheat varieties and species to stripe rust. In 1936 Newton and Johnson (*7*) published the results of similar studies for a number of varieties of wheat grown in Canada and the United States. Others (*2, 8, 9*) have reported similar tests in different countries.

The investigations reported in this circular were carried out at the Idaho Agricultural Experiment Station over a period of years and include both field and greenhouse studies. J. M. Raeder, of the Idaho station, conducted a portion of the investigations with barley, the remainder being carried out by the writer. The studies include nearly all of the wheat varieties grown commercially in the United States and a large number of recent introductions, and a number of varieties of barley and rye.

MATERIALS AND METHODS

A total of 317 varieties of wheat grown in the United States and 1,284 foreign introductions, including common, club, durum, emmer, poulard, and Polish wheats, 365 varieties of barley, and 11 of rye, were studied for their reactions to stripe rust. Some varieties were tested both in the field and in the greenhouse, others in the field only, and still others in the greenhouse only. Greenhouse tests were limited to seedling reactions, but in the field rust readings were made

[1] Approved by the director of the Idaho Agricultural Experiment Station as Research Paper No. 159.
[2] Italic numbers in parentheses refer to Literature Cited, p. 14.

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when the plants were in the soft-dough stage of maturity.[3] The inoculum used for the greenhouse tests consisted of physiologic race 19, while the field data resulted from natural infection which may have included other races. Most of the domestic varieties of wheat tested have been described by Clark and Bayles (*1*).

In the field, all varieties were grown in 6-foot rows 1 foot apart. In the greenhouse the plants were grown in 6-inch pots. The latter were inoculated in the one-leaf stage with a spore suspension made by scraping the spores from an infected leaf with a scalpel into a single drop of water on an ordinary glass slide. A small flattened needle was used to apply the spore suspension to the leaf.

The prevalence and severity in the field were determined by the standard method adopted by the Division of Cereal Crops and Diseases, Bureau of Plant Industry (*6*). The "host response" was recorded according to the following reaction equivalents: 0.0=immune, 0.1=apparently immune, 0.2=extremely resistant, 0.3=very resistant, 0.4=moderately resistant, 0.5=fairly resistant, 0.6=semiresistant (intermediate or mesothetic), 0.7=fairly susceptible, 0.8=moderately susceptible, 0.9=very susceptible, and 1.0=completely susceptible.

EXPERIMENTAL RESULTS

REACTION OF WHEAT VARIETIES

Table 1 presents a comparison of results secured in the field and greenhouse with 329 varieties of wheat, mostly from the United States. There are also 12 foreign varieties that have shown a specialized or interesting reaction to stripe rust in experiments at Moscow, Idaho, or in foreign countries. These are Carsten V, Holzapfel Früh, Little Joss, Lutescens, Spalding Prolific, Strube Dickkopf, Vilmorin Blé rouge d'Ecosse, Chinese 166, Brevit, Heine Kolben, Rouge Prolifique Barbu, and Similis.

TABLE 1.—*Comparative reaction to stripe rust of varieties of wheat grown in the field and in the greenhouse at Moscow, Idaho*

Variety	C. I. No.[1]	Greenhouse (seedling stage)			Field (soft-dough stage)			
		Number of plants		Infection type	Prevalence[2]	Percent of severity[2]	Host response	Infection coefficient[3]
		Inoculated	Infected					
Hard red winter:								
Alton	1438	12	10	4	10	T	0.9	T
Ashkof	6680	10	0	0	T	T	.3	T
Bacska	6156	10	8	1−	20	2	.5	1
Beloglina	1543	12	0	0	0	0	0	0
Beloglina selection	8884	12	0	0	0	0	0	0
Beloglina × Hussar	11513	12	10	0	0	0	0	0
Blackhull	6251	12	0	0	0	0	0	0
Cheyenne	8885	8	0	0	0	0	0	0
Eagle Chief	8868	10	2	1	0	0	0	0
Early Blackhull	8856	10	0	0	0	0	0	0

[1] C. I. refers to accession number of the Division of Cereal Crops and Diseases, formerly Office of Cereal Investigations.

[2] T−=0.1; T=0.2; T+=0.3.

[3] Coefficient is the result of multiplying the percent of severity by the host-response factor; T=trace of infection, i. e., less than 0.5.

[3] Host response as expressed by infected plants in the field nursery may be expressed for plants grown in greenhouse cultures in terms of infection type in the following equivalents: 0.0=0, 0.1=1−, 0.2=1, 0.3=2−, 0.4=2, 0.5=X−, 0.6=X, 0.7=3−, 0.8=3, 0.9=4−, 1.0=4.

TABLE 1.—*Comparative reaction to stripe rust of varieties of wheat grown in the field and in the greenhouse at Moscow, Idaho*—Continued

Variety	C. I. No.	Greenhouse (seedling stage)			Field (soft-dough stage)			
		Number of plants		Infection type	Prevalence	Percent of severity	Host response	Infection coefficient
		Inoculated	Infected					
Hard red winter—Continued.								
Eureka × Minhardi	8036	10	0	0	0	0	0	0
Fulhard	8257	10	0	0	0	0	0	0
Hussar	4843	12	6	2	T	T	.2	T
Ilred	8219	7	3	4−	0	0	0	0
Iobred	6934	12	0	0	T	T	.4	T
Iowa No. 404	5580	12	0	0	0	0	0	0
Iowin	10017	11	0	0	0	0	0	0
Jenkin × Ridit	10081	10	10	3	10	3	.9	3
Kanred	5146	10	0	0	T−	T−	.2	T
Kanred × Minhardi	8040	12	0	0	T	T+	.4	T
Do	8042	12	0	0	T	T	.2	T
Karmont	6700	9	4	4	0	0	0	0
Kharkof	1442	10	6	4−	10	T	.2	T
Michikof	6990	12	7	4	5	T+	.6	T
Minard	6690	11	6	4	40	8	1.0	8
Minard × Minhardi	8889	9	0	0	0	0	0	0
Do	8219	11	0	0	0	0	0	0
Minhardi × Minturki	8215	11	0	0	0	0	0	0
Do	8034	10	0	0	0	0	0	0
Minturki	6155	12	7	2	0	0	0	0
Montana No. 36	5549	12	0	0	0	0	0	0
Mosida	6688	12	9	X−	8	5	.4	2
Nebraska No. 6	6249	10	7	3	T	T	.4	T
Nebraska No. 42	10041	10	0	0	0	0	0	0
Nebraska No. 60	6250	9	0	0	0	0	0	0
Newturk	6935	12	4	2	T	T	.4	T
Oro	8220	8	0	0	0	0	0	0
Patrick	10040	8	0	0	0	0	0	0
Pedigreed Blackhull No. 60	8857	10	0	0	0	0	0	0
Quivira	8886	10	0	0	0	0	0	0
Regal	7364	4	3	X−	10	2	.8	2
Relief	10082	11	11	4−	20	4	.7	3
Ridit	6703	11	0	0	0	0	0	0
Ridit × Utah Kanred	11696	10	7	3	10	T+	.8	T
Do	11604	11	0	0	0	0	0	0
Do	11686	11	0	0	0	0	0	0
Do	11687	11	0	0	10	2	1.0	2
Do	11597	11	0	0	0	0	0	0
Do	11598	11	0	0	0	0	0	0
Do	11599	10	0	0	0	0	0	0
Rio	10061	12	10	4−	50	10	1.0	10
Sherman	4430	7	0	0	T	T	.2	T
Superhard	8054	12	0	0	0	0	0	0
Tenmarq	6936	10	8	4	0	0	0	0
Turkey	6175	11	0	0	T−	T−	.1	T
Turkey × Bearded Minnesota 48	8243	12	12	4	80	20	1.0	20
Turkey-Hybrid 128 × Hussar	11699	10	7	3	20	5	.9	5
Turkey selection	10015	12	0	0	0	0	0	0
Do	10016	10	0	0	5	T+	.2	T
Do	11376	11	8	1	T	T	.2	T
Do	7366	9	7	1	10	2	.2	T
Do	11530	10	0	0	T	T	.2	T
Do	1532	12	8	X−	T	T	.4	T
Wheat and Rye	8890	9	0	0	0	0	0	0
Wisconsin Pedigree No. 2	6683	10	0	0	0	0	0	0
Wisconsin 21.25	10018	10	0	0	0	0	0	0
Wisconsin 18.4	10019	10	0	0	0	0	0	0
Yogo	8033	9	0	0	0	0	0	0
Zuni	10027	9	0	0	0	0	0	0
Soft red winter:								
Ashland	6692	11	2	3	30	10	.8	8
Berkeley Rock	8272	11	0	0	T	T	.2	T
Buffum No. 17	3330	9	0	0	T	T	.1	T
Carsten V	11768	6	0	0	0	0	0	0
China	180	12	0	0	0	0	0	0
Clarkan	8858	10	0	0	0	0	0	0
Climax	6203	11	10	2	T	T	.2	T
Cox	5240	11	0	0	T	T	.5	T
Currell	3326	8	6	4−	10	2	.8	2
Denton	8265	11	0	0	0	0	0	0
Diehl-Mediterranean	1395	12	0	0	0	0	0	0

TABLE 1.—*Comparative reaction to stripe rust of varieties of wheat grown in the field and in the greenhouse at Moscow, Idaho*—Continued

Variety	C. I. No.	Greenhouse (seedling stage)			Field (soft-dough stage)			
		Number of plants		Infection type	Prevalence	Percent of severity	Host response	Infection coefficient
		Inoculated	Infected					
Soft red winter—Continued.								
Dunbar	10029	10	6	4	10	3	1.0	3
Dutro Clipper	10035	8	0	0	0	0	0	0
Early Orange	10030	10	0	0	0	0	0	0
Flint	6307	6	6	4—	25	5	.8	4
Forward	6691	9	0	0	T	T	.1	T
Fulcaster	6471	10	7	3	10	3	.8	2
Do	4862	10	7	1	T	T	.8	T
Fulhio	6999	8	6	1—	0	0	0	0
Fultz	3416	11	8	3	T	T	.4	T
Fultzo-Mediterranean	4811	12	3	1	25	5	.8	4
Gipsy	3436	10	0	0	0	0	0	0
Gladden	5644	10	0	0	0	0	0	0
Gleason	8897	10	6	4	T+	T	1.0	T
Goens	4857	12	0	0	T	T	.1	T
Do	10034	12	0	0	0	0	0	0
Gold Drop	6316	9	0	0	T	T	.2	T
Golden Van	10032	11	0	0	0	0	0	0
Grandprize	4876	12	0	0	10	T	.4	T
Harvest Queen	6199	10	0	0	T	T	.4	T
Hohenheimer	11458	7	0	0	0	0	0	0
Holzapfel Früh	11771	8	0	0	0	0	0	0
Homer	6328	12	0	0	0	0	0	0
Hosar	10067	8	0	0	0	0	0	0
Hussar×Hohenheimer	10068–1	10	0	0	0	0	0	0
Illini Chief	5406	8	0	0	0	0	0	0
Illini Rustproof	10033	11	0	0	0	0	0	0
Imperial Amber	5338	10	0	0	0	0	0	0
Jones Fife	5608	11	11	4	100	90	1.0	90
Kawvale	8180	11	0	0	T	T	.2	T
Leap	4823	11	5	2	0	0	0	0
Little Falls	10026	8	0	0	0	0	0	0
Little Joss	6730	9	9	0	T	T	.2	T
Lofthouse	3275	8	0	0	0	0	0	0
Lutescens	8896	10	0	0	0	0	0	0
Mammoth Red	2008	10	2	1—	T	T	.4	T
Mealy	3358	7	0	0	0	0	0	0
Mediterranean	5303	11	3	2	0	0	0	0
Michigan Amber 29–1–1–1	11770	8	0	4	100	50	1.0	50
Minhardi	5149	10	5	3	0	0	0	0
Missouri Queen	10031	9	0	0	0	0	0	0
Nabob	8869	11	0	0	0	0	0	0
Nebraska No. 28	5147	12	6	3	10	T	.5	T
Nigger	5366	10	0	0	0	0	0	0
Nittany	6962	6	0	0	0	0	0	0
Oakley	6301	12	0	0	15	2	.4	1
Odessa	4475	12	0	0	10	2	.8	2
Penquite	5948	11	0	0	0	0	0	0
Peterson	5538	10	0	0	0	0	0	0
Poole	3488	12	10	4	15	5	1.0	5
Portage	5654	8	0	0	20	5	.8	4
Prosperity	5380	10	7	2	T+	T	.4	T
Purkof	8381	6	4	3	0	0	0	0
Purplestraw	1915	10	0	0	10	T	.8	T
Raupp	10038	9	0	0	0	0	0	0
Red Chief	3392	10	0	0	0	0	0	0
Red Clawson	3393	11	7	3	T	T	.4	T
Redhart	8898	11	0	0	0	0	0	0
Red Indian	8382	10	10	4	T	T	1.0	T
Red May	5336	10	0	0	20	4	.8	3
Red Rock	5597	10	0	0	0	0	.0	0
Red Russian	4509	12	0	0	0	0	0	0
Red Wave	3500	12	8	4	T	T	.4	T
Rice	5734	9	0	0	10	T	.4	T
Ridit×Pacific Bluestem	11450	12	0	0	0	0	0	0
Ridit×White Odessa	11449	10	7	X—	2	T	.4	T
Rochester	5693	9	0	0	10	2	.4	1
Ruddy	6465	9	0	0	0	0	0	0
Rudy	4873	11	0	0	T	T	.4	T
Rupert	5920	10	6	2	T+	T	.9	T
Rural New Yorker No. 6	5921	6	0	0	0	0	0	0
Russian	5137	8	0	0	0	0	0	0

TABLE 1.—*Comparative reaction to stripe rust of varieties of wheat grown in the field and in the greenhouse at Moscow, Idaho*—Continued

Variety	C. I. No.	Greenhouse (seedling stage)			Field (soft-dough stage)			
		Number of plants		Infection type	Prevalence	Percent of severity	Host response	Infection coefficient
		Inoculated	Infected					
Soft red winter—Continued.								
Russian Red	5928	11	5	3	T+	T	0.4	T
Shepherd	6162	10	8	2	T+	T	.4	T
Sibley	5666	12	0	0	0	0	0	0
Silversheaf	2496	10	0	0	T	T	.8	T
Sol	6009	10	0	0	0	0	0	0
Spalding Prolific	11766	10	0	0	0	0	0	0
Squarehead Master	4298	8	8	0	0	0	0	0
Strube Dickkopf	11767	11	0	0	0	0	0	0
Sutton	10053	9	0	0	0	0	0	0
Triplet	5408	12	8	2	5	T	.4	T
Trumbull	5657	12	2	1	T	T	.2	T
Valley	5923	7	0	0	10	5	.9	5
Vilmorin Blé rouge d'Ecosse	11769	9	0	0	0	0	0	0
V. P. I. 131	10047	10	0	0	0	0	0	0
Walker	6445	12	8	4	T	T	.4	T
Wheedling	4816	11	6	2	0	0	0	0
Winter Chief	4878	10	0	0	0	0	0	0
Wyandotte	3549	11	5	3	T	T	.8	T
Zimmerman	2907	8	0	0	T−	T−	.1	T−
White winter:								
Chinese 166	11765	10	10	1−	100	50	1.0	50
Dawson	3342	10	7	2	0	0	0	0
Democrat	3384	10	0	0	0	0	0	0
Eaton	4682	6	0	0	0	0	0	0
Genesee Giant	1744	10	7	X−	T+	T	.4	T
Goldcoin (Fortyfold)	4156	10	8	2	80	20	.4	8
Greeson	6320	7	0	0	0	0	0	0
Hard Federation × Martin	11488	9	0	0	0	0	0	0
Hard Federation × Martin selection	11691	12	4	3	T	T	.8	T
Do	11692	11	0	0	0	0	0	0
Heil Dickkopf × Silvercoin	11697	11	0	0	0	0	0	0
Hohenheimer × Goldcoin	11698	8	0	0	0	0	0	0
Honor	6162	8	3	2	T	T	.4	T
Hybrid 128-White Odessa × Utah Kanred	11602	12	6	4	20	6	1.0	6
Junior No. 6	6971	8	3	1−	T	T	.2	T
Kofod	4337	10	2	1	T	T	.2	T
Longberry No. 1	5823	9	0	0	0	0	0	0
Martin	4463	10	6	3	5	2	.8	2
Prohibition	4068	8	0	0	0	0	0	0
Read	6401	10	10	4	25	5	1.0	5
Rex	10065	8	0	0	T	T	.2	T
Rex selection	11689	5	0	0	0	0	0	0
Do	11690	6	0	0	0	0	0	0
Schonacher	5942	12	0	0	10	2	.4	1
Silvercoin	6013	10	2	1	T	T	.2	T
Smithsonian	10022	10	0	0	0	0	0	0
Treadwell	5332	11	0	0	T	T	.2	T
Triplet × White Odessa	11688	9	0	0	10	T	.8	T
Turkey-Florence	10080	12	0	1−	10	T	.2	T
White Mediterranean	10023	11	7	2	T	T	.4	T
White Odessa	4655	10	5	4	15	5	1.0	5
White Winter	5219	9	2	1−	0	0	0	0
White Wonder	6450	8	0	0	60	5	.4	2
Windsor	5915	8	4	2	T	T	.4	T
White spring:								
Allen	5407	9	0	0	0	0	0	0
Baart	1697	9	6	3	T+	T	1.0	T
Bunyip	5125	12	10	4	15	5	1.0	5
Defiance	6477	11	0	0	0	0	0	0
Dicklow	3663	10	0	0	T	T	.1	T
Early Defiance	6480	12	12	3	T+	T	.8	T
Federation	4734	10	10	4	10	3	1.0	3
Foisy	5246	10	0	0	0	0	0	0
Galgalos	2398	10	5	1−	0	0	0	0
Gypsum	4762	8	0	0	T+	T	.8	T
Hard Federation	4980	10	7	4	T	T	.8	T
Hyper	8875	9	0	0	0	0	0	0
Indian	4489	10	0	0	0	0	0	0
Irwin Dicklow	8855	10	0	0	0	0	0	0

TABLE 1.—*Comparative reaction to stripe rust of varieties of wheat grown in the field and in the greenhouse at Moscow, Idaho*—Continued

Variety	C. I. No.	Greenhouse (seedling stage)			Field (soft-dough stage)			
		Number of plants		Infection type	Prevalence	Percent of severity	Host response	Infection coefficient
		Inoculated	Infected					
White spring—Continued.								
Mackey	10028	10	0	0	0	0	0	0
New Zealand	6011	11	0	0	0	0	0	0
Onas	6221	11	6	4	10	T+	1.0	T
Oregon Zimmerman	7359	9	2	1−	T	T	1.0	T
Pacific Bluestem	4067	11	11	4	50	20	1.0	20
Palisade	4798	9	6	4	10	3	1.0	3
Pilcraw	5540	10	0	0	0	0	0	0
Do	10048	9	0	0	0	0	0	0
Do	10036	10	0	0	0	0	0	0
Powerclub	8276	9	0	0	T	T	.4	T
Propo	1970	10	10	4	T	T	1.0	T
Quality	6157	10	0	0	0	0	0	0
Regenerated Defiance	3703	11	8	2	0	0	0	0
Rink	5868	12	0	0	0	0	0	0
Sevier	6247	10	7	0	0	0	0	0
Sonora	3036	10	0	0	0	0	0	0
Surprise	2986	8	0	0	0	0	0	0
Talimka	2495	10	8	3	25	4	.9	4
Touse	6017	10	0	0	0	0	0	0
Utac	10045	10	0	0	0	0	0	0
White Federation	4981	11	8	4	60	10	1.0	10
Red spring:								
Brevit	3778	9	6	3	0	0	0	0
Ceres	6900	8	6	3	0	0	0	0
Champlain	4782	8	0	0	0	0	0	0
Chogat	6244	12	12	4	15	5	1.0	5
Chul	2227	8	8	4	20	5	1.0	5
Early Alberta	10025	11	9	4	T+	T	1.0	T
Garnet	8181	10	4	1−	0	0	0	0
Glyndon	2873	10	7	4	0	0	0	0
H-44	8177	8	0	0	0	0	0	0
Haynes Bluestem	2874	10	0	0	0	0	0	0
Heine Kolben	11772	8	7	3	80	20	.8	16
Humpback	3690	11	8	3	0	0	0	0
Huston	5208	8	0	0	0	0	0	0
Hybrid 100	10055	9	0	0	0	0	0	0
Hybrid 101	10054	10	0	0	0	0	0	0
Hybrid 63	10059	8	0	0	0	0	0	0
Java	4966	12	6	3	0	0	0	0
Kinney	5189	12	0	0	0	0	0	0
Kitchener	4800	11	8	4	0	0	0	0
Kota	5878	12	8	4	10	2	1.0	2
Ladoga	4795	10	7	4	30	5	1.0	5
Loros	3779	10	7	3	0	0	0	0
Marchassan	10057	8	0	0	0	0	0	0
Marquillo	6887	12	4	0	0	0	0	0
Marquis	3641	11	7	4	T	T	1.0	T
Marvel	8876	10	0	0	0	0	0	0
Missouri Valley	10046	10	0	0	0	0	0	0
Power	3697	8	0	0	0	0	0	0
Prelude	4323	10	8	4	25	5	1.0	5
Preston	3081	11	0	0	T	T	.2	T
Do	3328	10	0	0	T	T	.2	T
Progress	6902	10	7	4	20	5	1.0	5
Red Bobs	6255	10	3	3	0	0	0	0
Red Fife	3329	12	4	4	0	0	0	0
Reliance	7370	11	11	4	20	5	1.0	5
Renfrew	8194	11	0	0	0	0	0	0
Resaca	6390	9	0	0	0	0	0	0
Reward	8182	10	10	4	T	T	1.0	T
Romanow	10058	7	7	1−	0	0	0	0
Rouge Prolifique Barbu	11774	10	0	0	0	0	0	0
Ruby	6047	11	9	4	0	0	0	0
Schlanstedt	4646	9	0	0	0	0	0	0
Sea Island	6551	8	0	0	0	0	0	0
Siberian	10060	10	6	4	T	T	1.0	T
Similis	3747	10	7	3	0	0	0	0
Sommervelt	8853	9	0	0	0	0	0	0
Stanley	4796	10	7	4	40	10	1.0	10
Supreme	8026	4	0	0	0	0	0	0
Thatcher	10003	8	0	0	0	0	0	0

TABLE 1.—*Comparative reaction to stripe rust of varieties of wheat grown in the field and in the greenhouse at Moscow, Idaho*—Continued

Variety	C. I. No.	Greenhouse (seedling stage)			Field (soft-dough stage)			
		Number of plants		Infection type	Prevalence	Percent of severity	Host response	Infection coefficient
		Inoculated	Infected					
Red spring—Continued.								
Tulm	10056	10	6	4	T	T	1.0	T
Vermillion	8877	8	0	0	0	0	0	0
Webster	3780	11	7	3	0	0	0	0
Whiteman	8379	10	0	0	0	0	0	0
Club:								
Albit	8275	10	7	3	T	T	.4	T
Big Club	4275	7	0	0	0	0	0	0
Bluechaff	5256	8	6	4	T	T	1.0	T
Coppei	3088	12	10	3	T	T	.5	T
Dale	4155	11	6	3	10	2	.9	T
Hybrid 63	4510	12	8	4	0	0	0	0
Hybrid 123	4511	12	8	3	T+	T	1.0	T
Hybrid 128	4512	11	10	4	90	10	1.0	10
Hybrid 143	4160	8	8	3	60	10	.8	8
Hybrid 128×Martin	11606	12	10	4	100	40	1.0	40
Hybrid 128×White Odessa	11607	12	9	4	100	50	1.0	50
Hymar	11605	12	5	4	100	30	1.0	30
Jenkin	5177	10	10	4	5	T+	1.0	T
Little Club	4066	12	10	4−	50	20	1.0	20
Redchaff	4241	10	6	4	10	2	1.0	2
Durum:								
Acme	5284	8	0	0	0	0	0	0
Akrona	6881	8	0	0	0	0	0	0
Arnautka	1494	8	0	0	0	0	0	0
Barnatka	8214	9	0	0	0	0	0	0
Golden Ball	6227	8	0	0	0	0	0	0
Kahla	5529	9	6	2	0	0	0	0
Kubanka	1440	8	6	2	T	T	.4	T
Marcuani	1593	8	0	0	0	0	0	0
Mindum	5296	9	6	3	T	T	.8	T
Monad	3320	9	0	0	T	T	.8	T
Mondak	7287	8	6	4	0	0	0	0
Nodak	6519	8	6	4	0	0	0	0
Peliss	1584	7	0	0	0	0	0	0
Pentad	3322	9	0	0	0	0	0	0
Minor species:								
Vernal (emmer)	1524	6	0	0	0	0	0	0
Black Winter (emmer)	2337	10	8	4	50	10	1.0	10
Khapli (emmer)	4013	9	3	3	20	5	.8	4
Alstroum (spelt)	1773	8	0	0	0	0	0	0
Einkorn	2433	10	0	0	0	0	0	0
White Polish (Polish)	3007	7	0	0	0	0	0	0
Alaska (poulard)	5988	5	0	0	T	T	.1	T
Mongolian (poulard)	10024	12	8	4	10	5	1.0	5

Of the 69 hard red winter varieties studied, 65.2 percent were immune, 14.5 percent resistant, and 20.3 percent susceptible in the seedling stage in the greenhouse. In the soft-dough stage, in the field, 58 percent were immune, 27.5 percent resistant, and 14.5 percent susceptible. A resistant type was considered as any variety giving a "host response" of 0.1 to 0.5. Some two dozen varieties were susceptible in the seedling stage and either resistant or immune in the soft-dough stage, but only a single variety (Chinese 166) was really susceptible in the soft-dough stage and extremely resistant in the seedling stage. The first instance was not unexpected, because, in the case of other cereal rusts, it has been reported that a variety, susceptible in the seedling stage, might be resistant as it approached maturity. The varieties Illred, Karmont, and Tenmarq, to name only a few, were susceptible in the seedling stage and either resistant

or immune under field conditions. The striking difference in the reaction of Chinese 166 is very likely due to the presence of another rust race in the field, such as race 28, for example. Among the more common varieties, Blackhull, Cheyenne, Kanred, Oro, Ridit, and Turkey (C. I. 6175) are resistant to or immune from physiologic race. No. 19, as they were also in the field.

For the soft red winter class, the average infection coefficient is 1.9 (derived by dividing the sum of infection coefficients of a given class by the total number of varieties in that class), which indicates that the class as a whole is resistant to stripe rust but not so much so as the hard red winter class, which had an average infection coefficient of 0.9. Approximately 70 percent of the varieties of this class were either immune or resistant in both the seedling and soft-dough stages. Fulhio, Nittany, and Red Rock were the three most important commercial varieties in this class that showed resistance. Others of less importance, such as Denton, Diehl-Mediterranean, and Gladden, were immune.

Democrat, Eaton, Hard Federation × Martin, and Rex selection (C. I. 11689) were the most resistant varieties in the white winter class. The average coefficient of infection for this class was 2.4. Approximately 80 percent of the varieties were resistant or immune.

The white and red spring classes were about the same in average infection coefficient, being 1.4 and 1.1, respectively. Defiance, Dicklow, and Irwin Dicklow are representative of the resistant varieties in the white spring class, whereas some of the more common varieties, such as Baart, Federation, and Onas, were extremely susceptible. Garnet, H–44, Haynes Bluestem, and Thatcher were resistant varieties in the red spring class.

Club wheat, as a class, was much more susceptible than any of the others. The average infection coefficient was 10.9, which is considerably higher than that of any of the other classes studied. Big Club was the only variety resistant in both the seedling and soft-dough stages. Hybrid 63 was resistant under field conditions but extremely susceptible in the seedling stage. All the other varieties were extremely susceptible.

Only 3 of the 14 durum varieties studied, Kubanka, Mindum, and Monad, showed any susceptibility in the field. Two others, Mondak and Nodak, were susceptible in the seedling stage but not in the soft-dough stage.

Of the minor wheat species studied, Vernal (emmer), Alstroum (spelt), Einkorn, White Polish (Polish), and Alaska (poulard) were resistant, whereas Black Winter (emmer), Khapli (emmer), and Mongolian (poulard) were susceptible.

Detailed data for 1,272 of the 1,284 introductions are not given because of their limited economic value. Most of them came from China, but others had been secured from Russia (Union of Soviet Socialist Republics), Caucasia, Iraq, Manchuria, Siberia, Australia, Spain, Japan, Afghanistan, Hungary, Guatemala, Dalmatia, Greece, France, and Iran (Persia). All of the Chinese varieties were susceptible, with the exception of the following: C. I. Nos. 10215, 10227, 10232, 10239, 10240, 10308, and 10311. Resistant varieties among the introductions from the other countries are too numerous to mention.

REACTION OF BARLEY VARIETIES

The seed of the barley varieties used in this study was supplied by the Division of Cereal Crops and Diseases. Most of these varieties have been described (*3*).

The inoculum used in testing the barley varieties against stripe rust was taken from wheat. Excellent infection resulted on the susceptible varieties, further substantiating the suggestion of other workers that the existence of a hordei race of *Puccinia glumarum* in this country is somewhat doubtful.

Table 2 shows the rust reaction of 365 varieties of barley, grown in the greenhouse and inoculated with stripe rust during the seedling stage.

TABLE 2.—*Reaction to stripe rust of barley seedlings grown in the greenhouse at Moscow, Idaho* [1]

Variety	C. I. No.	Number of plants		Infection type
		Inoculated	Infected	
Abacus	1088	10	0	0
Abed Binder	1081	10	5	1
Abyssinia	361	8	0	0
Do	362	11	0	0
Do	672	8	0	0
Do	676	8	3	1—
Do	946	7	0	0
Do	949	10.	5	1
Do	950	7	1	1—
Do	943	2	1	1—
Do	951	9	2	1
Abyssinian	1216	8	0	0
Do	1218	7	0	0
Do	1219	8	0	0
Do	1220	8	0	0
Do	1221	8	1	1
Do	1222	8	1	4
Do	1223	9	0	0
Do	1224	6	3	3
Do	1225	7	0	0
Do	1226	8	4	4
Do	1227	10	0	0
Do	1228	10	0	0
Do	1229	10	0	0
Do	1230	8	4	3
Do	1231	9	0	0
Do	1232	9	0	0
Do	1233	10	2	4
Do	1241	9	3	4
Do	1242	10	6	3
Do	1243	10	0	0
Do	1234	9	0	0
Do	1235	10	4	1—
Do	1236	10	2	4
Do	1237	10	2	1—
Do	1238	10	0	0
Do	1239	9	0	0
Do	1240	7	2	2
Abyssinian Intermediate	2514	10	0	0
Acanthus	1095	10	5	1
Ak-arpa	747	10	9	1—
Albacete	1128	10	9	4
Alcazar	1096	10	0	0
Alexis	968	11	0	0
Algerian	1179	6	5	2
Alpha	959	10	0	0
Amarillo	1073	5	10	1
Arabel	896	8	0	0
Arequipa	1256	8	0	0
Argentine	223	11	11	1—
Arlington Awnless	702	10	0	0
Azov	1028	10	2	1
Baker	975	8	0	0
Baku	253	8	2	1
Barbary	695	10	7	1—
Barbican	1265	6	4	2
Barquis	1076	11	0	0
Bashaw	1018	7	1	X—
Bema	1100	10	5	2
Benny	1288	10	0	0
Black Arabian	202	12	0	0
Black Egyptian	1246	8	0	0
Blackhull	878	8	0	0
Black Hull-less	618	10	0	0
Do	666	10	7	3
Blarney	1303	12	0	0
Blue Ribbon	611	10	0	0
Bohemian	27	12	0	0
Do	204	12	12	4
Do	1148	8	0	0
Bolivia	1257	8	2	4
Bolton	177	12	0	0
Broach	1101	8	4	4
Brutus	1011	9	0	0
Buchiang	1043	12	9	1
Buland	1084	6	0	0
Bungo	74	6	6	1—
Burley	1294	12	0	0
Caballero	1006	9	8	2—
Cadmus	1054	10	4	1—
Caliph	983	6	1	1—
Calotte	1102	10	0	0
Canada Winter	713	8	0	0
Canadian Thorpe	740	10	0	0
Cape	1026	9	0	0
Do	557	10	9	1—
Do	1268	10	0	0
Cartouch	1107	8	0	0
Catts	1283	9	0	0
Caucasian	714	8	0	0
Cebada	1055	9	2	1
Chalet	1110	8	0	0
Cheddar	1307	7	0	0
Cheliff	1074	10	0	0
Chevalier	1245	10	0	0
Do	278	10	2	1—

[1] For explanations see footnotes to table 1.

TABLE 2.—*Reaction to stripe rust of barley seedlings grown in the greenhouse at Moscow, Idaho*—Continued

Variety	C. I. No.	Number of plants		Infection type
		Inoculated	Infected	
Chevalier II	530	10	9	1
Chevron	1111	8	2	1
Child	2291	9	5	2
Chile Brewing	657	10	10	1—
Chile Common	663	10	0	0
Chilga-arpa	744	10	3	1—
Chinerme	1079	8	3	1
Chorny	875	10	0	0
Chusein	1039	10	6	1
Clancy	1002	10	4	1—
Claudia	1297	11	1	1—
Club Mariout	261	8	0	0
Coast	690	8	0	0
Do	691	10	0	0
Colorado	1075	8	0	0
Console	1112	8	0	0
Consul	1061	12	8	1
Coolie	1060	10	5	1
Corbel	1113	8	4	4
Cornutum	724	8	6	4
Cortile	1123	9	0	0
Creel	1298	8	0	0
Crimean Hull-less	320	8	0	0
Crocket	1094	8	3	1
Cromlech	1215	7	0	0
Crypt	1090	10	0	0
Cyma	1258	7	0	0
Czar	1005	9	4	1
Czech	1023	8	1	1—
Daniels	971	8	5	X—
Dehra	1085	11	2	2
Dentil	1260	7	1	1
Dinar	729	8	0	0
Donjon	1264	10	0	0
Eagle	1320	10	0	0
Do	913	8	0	0
Ederle	1015	10	3	1—
Eider	993	8	7	4—
Entresol	1261	9	1	2
Envoy	1045	10	6	2
Erak	1003	8	6	1
Eremo	1014	8	4	1
Evans	621	10	4	1
Exedra	1262	10	7	3
Featherston	1118	8	3	4
Do	1120	9	6	3
Feline	1284	9	2	3
Fengsein	1040	12	10	2
Filer	1059	9	5	1—
Finland	581	10	9	3
Fleche	1263	9	3	X—
Franconian	679	8	1	1—
Do	680	8	5	1
Frankish	953	10	1	1—
Gambrinus	1066	12	5	2
Garton 986	645	10	0	0
Gatami	575	10	7	3
Gehangir	1089	11	0	0
Ghest	979	9	0	0
Gobi	1058	10	0	0
Gold	1145	8	1	1
Golden Melon	958	7	0	0
Gopal	1091	9	0	0
Gorak	1086	9	2	1
Greece	221	10	0	0
Gurof	1099	10	5	2
Hankow	197	11	11	1—
Hanna	1122	8	0	0
Do	906	8	0	0
Do	24	12	0	0
Do	30	12	12	3
Do	203	10	10	2
Do	734	10	0	0
Hanna Pedigree	34	12	12	1
Hannchamont	1121	10	3	4
Hannchen	531	13	11	4
Do	602	9	9	1—
Han River	206	8	0	0
Hansee Hull-less	703	10	9	4
Harem	1019	7	1	1
Heil Hanna 1	681	8	5	1—
Heil Hanna 2	678	8	0	0
Heil Hanna 3	682	8	0	0
Hero	1286	6	0	0
Heron	1299	9	0	0
Hiangshan	1047	10	0	0
Hidalgo	1020	9	0	0
Hisein	1053	11	0	0
Hodge	932	7	1	1—
Hooded Spring	716	8	7	2
Hopper	1285	10	0	0
Horsford	877	8	0	0
Do	610	10	10	1
Hurst	1304	8	5	4
Huwan	1080	10	0	0
Imperial	617	10	0	0
India Hull-less	698	10	10	4
Invincible	590	10	0	0
Irisaka	1083	10	0	0
Italian	914	10	0	0
Ivory	865	10	8	1—
Jet	967	11	1	1
Judith	1038	10	7	1—
Juliaca	1114	13	0	0
July	1082	10	2	1—
Kamamugi	577	10	3	3
Kaosein	1042	10	7	1—
Khanaka	743	10	8	2
Kharsila Awnless	733	10	2	4
Khayyan	1117	8	2	3
Kinver	1029	10	0	0
Kinver Chevalier	587	10	2	1—
Kipper	1291	8	0	0
Kirgis	1253	9	2	3
Kitchen	1296	10	0	0
Kite	992	9	3	1—
Kok-arpa	746	10	3	1—
Kolter	987	10	5	1
Kopeck	869	10	0	0
Koran	1063	11	0	0
Korsbyg	918	10	0	0
Kumfilde	730	10	0	0
Kurof	1098	10	5	1—
Kusan	1315	6	6	4
Kwan	1016	10	0	0
Ladrone	696	10	8	2
Lake City	1126	9	2	4—
Large-Grained Winter	408	5	0	0
Leader	1282	8	0	0
Leh	700	10	10	4
Leopold	1057	10	1	1—
Lihor	866	10	9	1—
Liland	1323	10	0	0
Limerick	1302	9	3	1
Lion	923	12	0	0
Lompoc	1312	9	0	0
Losein	1070	10	9	1
Louden	1308	7	5	2
Luth	908	8	0	0
Do	972	9	1	1—
Mahrische	912	8	0	0
Maltster	1025	6	5	1
Malting	1129	10	0	0
Manchuria	245	10	6	1—
Do	1178	9	3	4
Do	956	9	8	4—

TABLE 2.—*Reaction to stripe rust of barley seedlings grown in the greenhouse at Moscow, Idaho*—Continued

Variety	C. I. No.	Number of plants: Inoculated	Number of plants: Infected	Infection type
Manchuria Pedigree	1244	9	0	0
Manchurian	1251	10	2	2
Mandarin	981	6	2	1–
Mecca	1051	10	0	0
Meloy	1176	10	0	0
Memesh	593	10	0	0
Merv	667	10	0	0
Do	671	8	0	0
Michung	1160	10	5	4
Mignon	999	10	0	0
Milan	424	8	8	3
Minnesota	576	8	6	3
Misein	1062	10	2	1–
Moldavia	392	12	0	0
Monte Cristo	1017	10	4	1–
Moravian	965	9	5	1–
Moy Wah	1064	12	0	0
Nakano Wase	754	10	0	0
Nani Tal	1087	9	0	0
Nanook	1329	10	0	0
Nekludowi	1000	8	3	1–
Nepal	247	10	2	1
Do	475	11	11	2
Do	533	11	10	2
Do	250	8	0	0
Do	262	8	0	0
Do	595	10	10	1–
Do	598	10	0	0
Do	1290	10	0	0
Do	1292	9	0	0
Nesbian	647	10	10	1–
Niger	1301	8	8	1–
Niver	737	10	0	0
Norfut	1007	7	0	0
Notherson	1093	8	8	2
Oderbrucker	1174	9	0	0
Do	1137	10	5	1
Do	957	8	8	4–
Do	969	10	4	1
Odessa	961	10	0	0
Do	916	10	0	0
Do	182	12	10	3
Do	974	7	0	0
Omar	898	8	0	0
Orel	351	9	9	4
Oswong	697	10	0	0
Pannier	1330	8	8	4
Pasha	984	8	2	1–
Pasvolski	1103	8	0	0
Paulina	963	9	0	0
Peru	707	8	0	0
Do	653	10	8	2
Peruvian	1131	10	0	0
Petro	994	10	0	0
Phoebe	1305	12	0	0
Pickett	1004	9	8	3
Poda	652	10	0	0
Pontius	731	10	0	0
Popeline	704	8	0	0
Poppenheim	314	10	0	0
Prentice	917	10	0	0
Primus	532	12	11	1–
Princess	529	10	0	0
Do	603	10	10	1
Quinn	1024	7	3	1
Rasput	996	8	4	1–
Redfield	1295	11	0	0
Red River	973	8	5	2
Royal	1252	10	3	3
Ruble	870	10	0	0
Saggia	1316	10	0	0
Santizo	1049	10	0	0
Sangatuska	78	12	12	4
Scarab	995	9	2	1–
Scottish Pearl	277	10	2	1–
Semet	1314	9	0	0
Semir	1255	10	2	3
Servian	915	10	0	0
Shale	988	4	4	4–
Sirroche	1289	10	1	1
Squarehead	1267	8	0	0
Squarehead Winter	252	6	0	0
Squiers	1072	9	5	1
Steigum	907	8	0	0
Striegum	47	12	12	2
Sultan	997	9	6	X–
Sulu	1022	8	2	1–
Sumson	1092	10	4	1
Surprise	171	12	4	1–
Do	171a	12	0	0
Svanhals	187	11	11	1–
Syria	1259	8	0	0
Taihu	868	9	0	0
Tanbash	578	10	7	3
Tanchang	1164	9	0	0
Telli	194	10	8	1–
Tennessee Winter	876	8	0	0
Texas Winter	554	11	9	1–
Theda	1293	10	3	1
Theodore	1300	9	0	0
Tivannes	1109	8	2	1
Tonot	1012	7	0	0
Trebi	936	10	0	0
Tripoli	1115	10	0	0
Turbat	1254	10	2	2
Turkestan Winter	711	8	0	0
Venus	736	10	0	0
Virginia Hooded	648	10	10	3
Vitz	1306	10	4	1
Wansnipe	1050	10	4	1
Weider	1021	8	0	0
White Moravian	977	10	5	1
White Smyrna	658	10	0	0
Do	195	12	12	1
Winter Club	592	6	0	0
Do	488	10	0	0
Wisconsin Winter	519	10	0	0
Woodrow	986	7	0	0
Wusein	1044	6	0	0
Yanehadaka	580	8	8	4
Youshan	1068	12	0	0
Zero	1287	6	0	0
Zond	1138	10	5	4

In the 365 barleys studied in the greenhouse, 49.3 percent had an immune type of reaction, 36.2 percent a resistant type, and 14.5 percent of the varieties were susceptible to stripe rust. Most of the susceptible ones are of little commercial value. Some of these and a few additional varieties were also studied under field conditions.

Those grown both in greenhouse and field gave the same reaction in both tests; therefore, the field data are not reported here. Some of the commercial varieties that were resistant in both tests were: Winter Club, Hannchen (C. I. 602), Meloy, and Horsford. Wisconsin Pedigree 38, grown only in the field, was resistant.

REACTION OF RYE VARIETIES

Table 3 shows the reaction of 11 varieties of rye to stripe rust when subjected to field and greenhouse tests.

TABLE 3.—*Reaction of 11 varieties of rye to stripe rust at Moscow, Idaho* [1]

Variety	C. I. No.	Greenhouse (seedling stage)			Field (soft-dough stage)			
		Number of plants		Infection type	Prevalence	Percent of severity	Host response	Infection coefficient
		Inoculated	Infected					
Abruzzes	40	10	3	1	0	0	0	0
Dakold	175	10	1	1—	0	0	0	0
Henry	138	10	0	0	0	0	0	0
North Dakota No. 9	--------	10	2	1—	0	0	0	0
Prolific Spring	--------	10	4	3	T	T	.7	T
Rimpau	126	10	2	1—	0	0	0	0
Rosen	195	20	7	2—	T	T	.3	T
Selection 23	--------	10	2	1	T	T	.4	T
Star	209	10	2	1—	T	T	.2	T
Swedish	137	10	2	1—	0	0	0	0
Von Rümker	173	20	0	0	0	0	0	0

[1] For explanations see footnotes to table 1.

Of the 11 varieties of rye studied, only Prolific Spring proved susceptible, and it was not completely so; 3 were resistant, ranging from extremely resistant to fairly resistant, while 7 appeared to be immune in the field test. In the greenhouse tests, slight infection occurred in these seven only under optimum conditions for rust development.

DISCUSSION

No attempt is made here to classify the wheat groups for relative susceptibility to stripe rust because varietal reactions cause exceptions in each group. In general, however, under the conditions of the investigations here reported, the common white group was more susceptible than either the soft red winter, hard red winter, or durum. The durum group was the most resistant of any. As has been shown previously by Hiltner (*4*), the club wheats, as a group, were the most susceptible, there being only one resistant variety in the entire group. As a whole, the wheat varieties seemed to be more susceptible in the seedling than in the soft-dough stage, owing probably to environmental conditions, as every precaution was taken in the greenhouse to keep conditions ideal for the development of the fungus. Under field conditions, infection in the seedling stage usually was much greater in the spring-sown varieties, while at heading time infection was, in most

cases, much greater in winter wheat. This probably was because of the difference in seasonal conditions, for at the time of heading of winter wheat in the Pacific Northwest, conditions are usually right for the best growth of this fungus. Spring-sown barley, however, showed no more infection than did fall-sown barley at any stage of growth. Not all of the barleys were tested in the field, but those tested showed no difference in the amount of infection. Another point of interest is the fact that no difference in type of reaction between the seedling and heading stages was noted in barley. This was more or less true for the varieties of rye also.

SUMMARY

A total of 317 American wheat varieties, including common, club, durum, emmer, poulard, and Polish wheats, 1,284 foreign introductions of wheat, 365 barley varieties, and 11 varieties of rye were tested for resistance to stripe rust in the field and greenhouse at Moscow, Idaho.

Blackhull, Cheyenne, Kanred, Oro, Ridit, and Turkey (C. I. 6175) were the most resistant varieties of hard red winter wheat grown commercially in the United States.

Fulhio, Nittany, and Red Rock are representative of the resistant varieties of the soft red winter wheats, and Garnet, H–44, Haynes Bluestem, and Thatcher showed the most resistance in the red spring group.

Of the white wheats, Defiance, Dicklow, and Irwin Dicklow were the most resistant varieties in the white spring group, and Democrat, Eaton, Hard Federation × Martin, and Rex selection (C. I. 11689) are representative of the white winter group.

Big Club was the only club variety that showed any resistance to stripe rust, the remainder being extremely susceptible.

The durums, as a group, were the most resistant of any, there being only three varieties, Kubanka, Mindum, and Monad, that showed any infection at all.

Some varieties, including Ilred, Karmont, Tenmarq, and a score of others, proved to be susceptible in the seedling stage and not in the soft-dough stage. Chinese 166 and to a very slight extent a few other varieties were susceptible when in the soft dough, although it was resistant in the seedling stage (a difference in physiologic races involved might be the explanation). The data for only 12 of the 1,284 foreign wheats tested in the field for resistance to stripe rust are reported because the remainder are of little interest in this country.

Some of the 365 barley varieties and a few additional ones were also studied under field conditions. Those grown both in greenhouse and field gave the same reaction in both tests; therefore, the field data are not reported here. Some of the commercial varieties that were resistant in both tests were: Hannchen (C. I. 602), Horsford, Meloy, and Winter Club. Wisconsin Pedigree 38, grown only in the field, was resistant.

Prolific Spring was the only variety of rye studied that showed any appreciable susceptibility. Seven varieties of rye appeared to be immune, while three were extremely to fairly resistant.

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